Ph.D SYNOPSIS
(SUBMITTED TO THE ANDHRA UNIVERSITY)

A STUDY ON SELECTION OF LANDFILL SITES FOR SOLID WASTE MANAGEMENT IN THE ENVIRONS OF GREATER VISAKHAPATNAM MUNICIPAL CORPORATION, ANDHRA PRADESH - A SPATIAL TECHNOLOGY APPROACH

RESEARCH SCHOLAR : **Neela Victor Babu**
Department of Geo-Engineering
College of Engineering (A)
Andhra University
Visakhapatnam – 530003

RESEARCH DIRECTOR : **Dr. P. Jagadeeswara Rao**
Professor of Geo-Engineering
College of Engineering (A)
Andhra University
Visakhapatnam – 530003

DEPARTMENT OF GEO-ENGINEERING
COLLEGE OF ENGINEERING (A), ANDHRA UNIVERSITY,
VISAKHAPATNAM – 530 003

2013

SYNOPSIS

The study entitled **"*A study on selection of landfill sites for solid waste management in the environs of Greater Visakhapatnam Municipal Corporation, Andhra Pradesh-A spatial technology approach*",** has been carried out to identify appropriate landfill sites for solid waste management in the study area, Visakhapatnam District, Andhra Pradesh. Improper solid waste discard, collection and traditional landfilling are the major issues to be addressed by the way of selecting landfill sites following the local and Pollution Control Board norms. Visakhapatnam is one of the highly populated and industrial areas besides having reserved forests in the city. Recent studies carried out by PCB revealed that the study area is one of the highly polluted cities in Andhra Pradesh. The Greater Visakhapatnam Municipal Corporation (GVMC) covering 545 km^2 occupying in 1143 km^2 study area is the major concern. The study area has been experiencing drastic increase in industrialization and urbanization. The haphazard urbanization is the major concern for improper discard of solid waste showing intense impact on environment, especially on the urban community. The work has been accomplished to evaluate the impact in a scientific manner, using both laboratory and field methods by following established methodology. The results obtained are valuable input for Visakhapatnam Municipal Corporation to take necessary measures in terms of solid waste management. The recommended landfill sites are obtained through GIS analysis in this work. This research work is presented in six chapters, the crux are summarized as below.

Objectives of the study

The aim of the study is to identify suitable landfill sites for municipal solid waste management. Besides, chemical characterization of solid waste and also ground water chemical quality deciphered, with a view to understand solid waste leachate characteristics. The study has been carried out with the following major objectives.

1. To study drainage and run-off characteristics.
2. To study slope of the area and its role in landmass denudation, run-off, ground water recharge and material flow.
3. To study road network for safe disposal of solid waste.

4. To study land use/land cover.
5. To study chemical composition of solid waste.
6. To study geomorphology and lineaments to understand fluvial cycle characteristics and geological structural condition.
7. To study geology of the area for identification of different rock types and structures.
8. To study the soil types.

Chapter-1

The detail presentation about study, location of the study area, brief presentation about physiography, soil, temperature and rainfall, demography, flora and fauna and climate are given. The significance of the study and the major and specific objectives, the methodology thereafter adopted and the most important related investigations carried out in India and abroad are summarized. The recent trends of this line of research have been given to the topic of the study.

Chapter-2

In this chapter, Survey of India toposheets, IRS-IC, P6-LISS-III satellite imagery, District soil map, District Geology and Mineral map-2000 and other collateral data have been used to delineate thematic maps such as drainage, road network, soil, geology, geomorphology, lineament pattern and land use/land cover. Slope map of the area is generated using ASTER-30 satellite data. The drainage pattern in the area reveals geological structure, soil condition, meteorological and anthropogenic activity. Radial, parallel, annular, dendritic and sub-dendritic drainage patterns are seen. Dendritic and sub-dendritic drainage patterns are altered by extensive urban built-up there by leading to flooding in urban areas during rainy season. Geomorphology of the study area including various geomorphic features was presented. About fourteen landform types are identified, out of which Pediplain shallow-weathered, Pediplain moderate-weathered and Pediplain deep-weathered are the major classes followed by, Structural hills and Denudational hills. Pediplain shallow-weathered are completely under urban built-up. In recent years, piedmont slopes are encroached by urban slums leading to reduction of vegetation in hills. The study area has been investigated for land use/land cover patterns following the guidelines of NRSC (1990). This study was based on Remote Sensing investigations as well as validation of

data by the extensive field work. The urban built-up, single crop and double crop land use and deciduous forest, plantation, scrub/degraded forest, gullied/ravinous land, tanks and reservoirs are the land cover classes. Faults and fractures are delineated as confirmed lineaments. Joints, shear zones, etc. are occupied by drainages delineated as inferred lineaments. Major lineaments are the places where landmass denudation is taking place. Therefore, inferred lineament areas are selected for the selection of landfill sites for solid waste management. The study area is covered by nine soil types out of which red soil is the major one, which covers 83% of the area. The area has khondalite, migmatite and quartzite rock types, belonging to metamorphic group. Khondalites rock is selected for landfill site selection, because it covers about 87% of the area. All thematic map information is attributed for the selection of landfill sites in the study area.

Chapter-3

This chapter is dedicated to present the detailed investigation of source of generation of solid waste and the average composition of the solid waste in the study area. The solid waste data collected and their analysis to arrive per capita generation of solid waste is estimated. Waste is generated from all categories including households, hotels, restaurants, commercial establishments, markets, temples, institutions, drain silt, street sweepings etc. Municipal solid wastes from the vegetable markets, Rythu bazars, and apartments and nearby villages have been assessed for estimation and analysis of solid waste. Thus the root means of improper solid waste discarding mechanism was established. Improper disposal of solid waste in the streets leads to ugly condition and spreading of diseases. Community cleaning is totally absent. Due to lack of segregation of waste at the sources, the rag pickers are contributing in segregation and collection of recyclables including newspapers, plastics and metals. The GVMC has conducted pilot project for door to door collection which is implemented only at certain areas, thus study area does not cover 100 percent households door to door collection system. The scenario of solid waste management of Greater Visakhapatnam Municipal Corporation area which is completely not in accordance with the environmental laws suggested by the Pollution Control Board is also justified. The various waste disposal methods and their merits and demerits were discussed. Detailed descriptions of the waste disposal by sanitary landfilling methods are given. The present study was carried out to find out an alternate landfill sites, because the Kapula Uppada

dump yard falls under GVMC limits, which are against to the local body and Pollution Control Board norms. In addition to selection of landfill sites for solid waste management, about eight municipal solid waste samples were collected from the municipal solid waste bins for chemical analysis revealing low calorific value and high moisture content. Chromium, copper and nickel contents are higher in urban areas.

Chapter-4

This chapter is intended to present the detailed investigation of groundwater quality in the study area. About 25 groundwater samples have been collected adjacent to unlined major sewage drains in order to establish pollutants in ground water. The groundwater samples were collected and analyzed. The parameters such as pH, EC, TDS, TH, BOD, COD, TA, Ca, Mg, Na, K, Cl, F, Fe, Al, Mn, Cu, Zn, Se, Rb, Cd, Pb, Co and other trace metals have been determined. These values were compared with WHO and BIS standards in order to assess potable and contamination limits from the sources of urban and industries.

Chapter-5

In this chapter, ERDAS/Imaging 9.1and ArcGIS 9.2, software packages were used for the analysis of landfill sites for solid waste management in the study area. To quantify the effects of solid waste disposal the thematic maps are created and database for each thematic map has been generated in GIS environment. Besides, the GIS output map can be used to understand the vulnerability areas for selection of landfill within the study area. Using the similar studies and the standardized data; the landfill selection has been established. The results suggest that the landfill sites identified by these techniques are most suitable sites for final disposal of the solid waste management to create a hygienic environment for the future generation.

Chapter-6

This chapter presents the summary of the work carried out and the most important conclusions and recommendations drawn are shown below.

1. In the study area, urban built-up land covers an area of 312.34 km^2 and rural built-up land covers 26.94 km^2. Migration of rural people from the rural areas in search of employment to the urban areas is resulting in unplanned settlements (slums) in urban areas.

2. The area under double crop covers 63.87 km^2 and the single crop covers 177.95 km^2 respectively. Cultivation is the major livelihood in the rural areas (other than GVMC area). A few patches of cultivable lands have also been identified in GVMC area.

3. Fallow land in the study area covers about 37.35 km^2 which implies that the area under irrigation is under the vagaries of climatic condition. Due to expansion of urbanization, the fallow lands are being converted into built-up.

4. Major reservoirs in the area are Meghadrigedda Reservoir, Kanithi Reservoir, Mudasarlova Reservoir and Gambheram Reservoir, which are the sources for industries and domestic use for Greater Visakhapatnam Municipal Corporation. Following the Pollution Control Board norms, a buffer of 1000 m has been followed in order to avoid contamination from the landfill sites.

5. Denudational hills are the major class followed by, Structural hills, Residual hill, Structural valley, Pediment slope and Inselberg. These geomorphic units are not suitable for municipal solid waste disposal site selection because these are elevated terrain elements.

6. Faults and fractures are delineated as confirmed lineaments. Major lineaments are the places where landmass denudation is taking place. The confirmed lineaments are the major streams (gedda) turned into unlined sewage drains polluting surface and groundwater. Inferred lineaments areas are not structurally controlled, hence they are considered for the selection of landfill sites for solid waste management.

7. The chemical analysis revealing higher contents of Al, Cr, Mn, Fe, Cu, Zn, As, C and, Pb are due to solid waste leachates into the groundwater. Parameters like Fe, Zn, and Al are in higher content than the prescribed norms of BIS, ICMR and WHO.

8. With the assigned weights to thematic maps 97 landfill sites have been identified in GIS analysis. Out of 97 sites, seven sites were finally selected as suitable areas for solid waste management. The landfill sites selected are 1) Kottatalarivani palem (1.81km^2), 2) Denduru (1.56km^2), 3) Yeduruvanipalem (1.07 km^2), 4) Pydivada Agraham (1.03 km^2), 5) Mantripalem (0.97 km^2), 6) Mindivanipalem (0.91km^2) and 7) Ramayogi Agraharam (0.89 km^2).

9. Based on the results, usage of these sites is recommended for solid waste management by the Greater Visakhapatnam Municipal Corporation.

10. The number of workers in the solid waste collection which is supported by vehicles should be added in great extent to make the city clean and hygienic.

11. The municipal corporation should create awareness among the Vizagites in order to segregate solid waste in the whole study area (GVMC) with respect to household level.

12. With my observation and the best of my findings the city should cope up with new sanitary landfill in order to minimize contamination level.